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persist in the belief that space is not divisible *ad infinitum,* can make no pretensions to geometrical demonstrations, and although they may be enlightened in other things, they will be very little in this; for one can easily be a very capable man and a bad geometrician." In the course of his argument, Pascal has some interesting things to say about the relations of unity and zero to the number system. Near the beginning of Section I, Pascal has considerable to say about definitions and the necessity of leaving some things in geometry undefined. He has this to say of those who insist on defining everything:

> "For there is nothing more feeble than the discourse of those who wish to define these primitive words (space, time, motion, number, equality). What necessity is there, for example, of explaining what is understood by the word *man*? Do we not know well enough what the thing is that we wish to designate by the term? And what advantage did Plato think to procure us by saying that he was a two-legged animal without feathers? As though the idea that I have of him naturally, and which I cannot express, were not clearer and surer than that which he gives me by his useless and even ridiculous explanation; since a man does not lose humanity by losing the two legs, nor does a capon acquire it by losing his feathers."

Volume 48 closes with Pascal's "Preface to the Treatise on Vacuum" and a very short "New Fragment of the Treatise on Vacuum." These have reference to Pascal's experimental work on atmospheric pressure. He repeated the experiments of Torricelli by which the pressure of the atmosphere could be estimated as a weight; and by what has been called "The Great Experiment of the Puy-de-Dôme" he confirmed Torricelli's theory of the cause of barometrical variations. In this experiment Pascal obtained at the same instant readings of the height of a column of mercury in a barometer tube at different altitudes.

The parts of The Harvard Classics which have been mentioned as representing the mathematical sciences are all contained in the four volumes 30, 34 39, 48. The number of pages in these parts is more than 250. The authors represented are Newcomb, Faraday, Kelvin, Helmholtz, DesCartes, Voltaire, Copernicus, Newton, and Pascal. The parts written by Voltaire tell at some length of the work of DesCartes and Newton, and contain references to Bernoulli, Leibnitz, Wallis, Fermat and Mercator. Thus it is seen that the mathematical sciences have not been altogether neglected. An interesting question for readers of the MONTHLY is this: What else relating to the mathematical sciences might Dr. Eliot have included in his "Five-Foot Shelf of Books"?

PROBLEMS AND SOLUTIONS.

EDITED BY B. F. FINKEL AND R. P. BAKER.

PROBLEMS FOR SOLUTION.

ALGEBRA.

When this issue was made up, no solutions had been received for number 406.

436. Proposed by WALTER H. DRANE, Cumberland University, Tenn.

The product of two numbers p and q may be obtained by dividing p by 2 successively, discarding remainders, until the quotient 1 is obtained and then multiplying q by 2 successively and adding those products, $2^i q$, which correspond to those quotients of p that are odd numbers.

E. g. 51 × 81. 25, 162; 12, 324; 6, 648; 3, 1,296; 1, 2,592.

$$51 \times 81 = 81 + 162 + 1{,}296 + 2{,}592 = 4{,}131.$$

Prove or disprove the truth of the above proposition.

437. Proposed by C. N. SCHMALL, New York City.

Given that $S_1, S_2, S_3, \cdots, S_k$ are the sums of k arithmetical series, each taken to n terms. The first terms are respectively 1, 2, 3, $\cdots$, k, and the common differences are 1, 3, 5, $\cdots$, $(2k - 1)$. Show that

$$S_1 + S_2 + S_3 + \cdots + S_k = \frac{nk(nk + 1)}{2}.$$

GEOMETRY.

When this issue was made up, no solutions had been received for numbers 446 and 449.

466. Proposed by HORACE OLSON, Chicago, Illinois.

Given the edges of a triangular pyramid, find the radius of the inscribed sphere.

467. Proposed by E. T. BELL, Seattle, Washington.

It is well-known that if i, j, k, l are concyclic points, W_i the Wallace line (frequently, and erroneously, called the Simson line), of i with respect to the triangle jkl, then W_i, W_j, W_k, W_l are concurrent, say in the point $\{i, j, k, l\}$. If 1, 2, 3, $\cdots$ denote concyclic points, prove that:

(i) $\{1, 2, 3, 4\}$, $\{1, 2, 3, 5\}$, $\{1, 2, 4, 5\}$, $\{1, 3, 4, 5\}$, $\{2, 3, 4, 5\}$ are concyclic; say on the circle $[1, 2, 3, 4, 5]$;

(ii) Starting with 1, 2, 3, 4, 5, 6, omitting each point in turn, by (i), six circles, are found; these are concurrent, say in the point $\{1, 2, 3, 4, 5, 6\}$;

(iii) Starting with 1, 2, 3, 4, 5, 6, 7, seven points of the kind in (ii) are found; these lie on a circle.

(iv) Continuing thus indefinitely, there is, in each case, finally a unique point or circle according as the number of initial points is even or odd. Also, at any stage, the point of concurrence or the circle bears a simple relation to the initial points: what is it?

[*Note.*—This problem is obviously connected with the theorems of Clifford (*Mathematical Papers*, pp. 38 and 410), but it is interesting to note that it may be completely solved by the methods of Euclid, Books I to III (but at considerable length), and hence is well within the range of high school students. But a very simple proof may be given by the methods of strictly elementary analytical geometry.]

468. Proposed by ELMER SCHUYLER, Brooklyn, New York.

Given two circles and a straight line, to draw a circle tangent to the line and coaxial with the two given circles.

469. Proposed by J. ALEXANDER CLARKE, West Philadelphia High School.

If in an isosceles triangle, a circle is described on one side as diameter, and a line is drawn through the mid-point of the side parallel to the base, the circle and the parallel will intercept on the *tri*sector of the angle at the vertex a segment equal to the radius of the circle. Show how this can be used to trisect any angle.

CALCULUS.

When this issue was made up, no solutions had been received for numbers 336, 338–340, 342, 348, 353, 360, and 363.

387. Proposed by C. N. SCHMALL, New York City.

Show that the volume bounded by the cone $x^2 + y^2 = (a - z)^2$ and the planes $x = 0$, $x = z$, is $\frac{2}{9}a^3$.

388. Proposed by PAUL CAPRON, U. S. Naval Academy.

If $f(x, y) = 0$ represents (in rectangular coordinates) a curve having a simple tangency to the axis of x at the origin, the value of $x^2/2y$, derived from $f(x, y) = 0$, and evaluated for $x = 0$, $y = 0$, will be the radius of curvature at the origin; or if the curve is similarly tangent to the y-axis at the origin, $y^2/2x$, evaluated for $x = 0$, $y = 0$, is the radius of curvature at the origin.